

What is claimed is:

1. A method of manufacturing a thin film magnetic head comprising a thin film coil for generating a magnetic flux and a magnetic pole layer having a magnetic pole tip portion for emitting the magnetic flux generated by the thin film coil toward a recording medium traveling in a predetermined medium travel direction, comprising:

a first step of forming a first photoresist layer in a pattern so as to have a shape in plan view corresponding to a shape in plan view of the magnetic pole layer;

a second step of forming a first gap layer so as to cover the first photoresist layer and a peripheral region of the first photoresist layer;

a third step of forming a second photoresist layer so as to cover the first gap layer;

a fourth step of exposing the first photoresist layer by etching at least the second photoresist layer and the first gap layer halfway;

a fifth step of removing the first and second photoresist layers to thereby form a magnetic pole formation region surrounded by the first gap layer in a region from which the first photoresist layer is removed;

a sixth step of forming the magnetic pole layer in a pattern in the magnetic pole formation region so as to extend from a recording medium facing surface which faces the recording medium in the direction away from the recording medium facing surface;

a seventh step of forming a second gap layer in a pattern on the magnetic pole layer to thereby surround the magnetic pole layer from three

directions of a medium outflow direction in the medium travel direction and two side directions orthogonal to the medium outflow direction by the first and second gap layers; and

an eighth step of forming a magnetic shield layer in a pattern on the first and second gap layers so as to extend from the recording medium facing surface in the direction away from the recording medium facing surface and to surround the magnetic pole tip portion of the magnetic pole layer from the three directions.

2. A method of manufacturing a thin film magnetic head according to claim 1, further comprising, before the first step,

a ninth step of forming a seed layer for performing a plating process in a pattern,

wherein the first photoresist layer is formed on the seed layer in the first step,

the seed layer is exposed in the magnetic pole formation region in the fifth step, and

the magnetic pole layer and the second gap layer are formed by growing a plating film by using the seed layer in the sixth and seventh steps.

3. A method of manufacturing a thin film magnetic head according to claim 2, wherein the ninth step includes the steps of:

forming a precursor seed layer; and

etching and patterning the precursor seed layer, thereby forming the seed layer.

4. A method of manufacturing a thin film magnetic head according to claim 2, wherein outline of the seed layer is set to be larger than that of the magnetic pole layer.

5. A method of manufacturing a thin film magnetic head according to claim 1, wherein the first step includes the steps of:

forming a precursor photoresist layer so as to include a portion having a width larger than the width of the magnetic pole tip portion; and

forming the first photoresist layer by narrowing the width of the portion having the width larger than the width of the magnetic pole tip portion by ashing the precursor photoresist layer.

6. A method of manufacturing a thin film magnetic head according to claim 1, wherein in the second step, the thickness of the first gap layer is set to 0.1 μm or less.

7. A method of manufacturing a thin film magnetic head according to claim 1, wherein in the fourth step,

etching is performed while emitting an ion beam from a direction forming an angle in a range from 65° to 70° with a direction orthogonal to a plane extended from the second photoresist layer by using ion milling.

8. A method of manufacturing a thin film magnetic head according to claim 1, wherein in the fourth step,

the first gap layer is etched so that the depth of the magnetic pole formation region formed in the fifth step becomes larger than the thickness of the magnetic pole layer.

9. A method of manufacturing a thin film magnetic head according to claim 2, wherein the eighth step includes the steps of:

forming a first magnetic shield layer portion as a part of the magnetic shield layer so as to extend from the recording medium facing surface in the direction away from the recording medium facing surface by growing a plating film by using the seed layer on the second gap layer in the magnetic pole formation region; and

forming the magnetic shield layer including the first and second magnetic shield layer portions by forming a second magnetic shield layer portion as another part of the magnetic shield layer so as to extend from the recording medium facing surface in the direction away from the recording medium facing surface on the first gap layer and the first magnetic shield layer portion and so as to surround the magnetic pole tip portion from the three directions.

10. A method of manufacturing a thin film magnetic head according to claim 1, wherein the magnetic pole layer is allowed to emit a magnetic flux

for magnetizing the recording medium in the direction orthogonal to the surface of the recording medium.

11. A method of manufacturing a thin film magnetic head comprising a thin film coil for generating a magnetic flux and a magnetic pole layer having a magnetic pole tip portion for emitting the magnetic flux generated by the thin film coil toward a recording medium traveling in a predetermined medium travel direction, comprising:

a first step of forming a first photoresist layer in a pattern so as to have a shape in plan view corresponding to a shape in plan view of the magnetic pole tip portion;

a second step of forming a first gap layer so as to cover the first photoresist layer and a peripheral region of the first photoresist layer;

a third step of forming a second photoresist layer so as to cover the first gap layer;

a fourth step of exposing the first photoresist layer by etching at least the second photoresist layer and the first gap layer halfway;

a fifth step of removing the first and second photoresist layers to thereby form a magnetic pole tip formation region surrounded by the first gap layer in a region from which the first photoresist layer is removed;

a sixth step of forming the magnetic pole tip portion in a pattern in the magnetic pole tip formation region so as to extend from a recording medium facing surface which faces the recording medium in the direction away from the recording medium facing surface;

a seventh step of forming a second gap layer in a pattern on the magnetic pole tip portion to thereby surround the magnetic pole tip portion from three directions of a medium outflow direction in the medium travel direction and two side directions orthogonal to the medium outflow direction by the first and second gap layers; and

an eighth step of forming a magnetic shield layer in a pattern on the first and second gap layers so as to extend from the recording medium facing surface in the direction away from the recording medium facing surface and to surround the magnetic pole tip portion from the three directions.

12. A thin film magnetic head comprising:

a thin film coil for generating a magnetic flux;

a magnetic pole layer having a magnetic pole tip portion for emitting the magnetic flux generated by the thin film coil toward a recording medium traveling in a predetermined medium travel direction, and extending from a recording medium facing surface which faces the recording medium in the direction away from the recording medium facing surface;

a first gap layer disposed so as to be adjacent to the magnetic pole layer in two side directions orthogonal to the medium outflow direction in the medium travel direction;

a second gap layer disposed so as to be adjacent to the magnetic pole layer in the medium outflow direction; and

a magnetic shield layer disposed so as to extend from the recording medium facing surface in the direction away from the recording medium facing surface and so as to surround the magnetic pole tip portion of the magnetic pole layer from three directions of the medium outflow direction and the two side directions via the first and second gap layers.

13. A thin film magnetic head comprising:

a thin film coil for generating a magnetic flux;

a magnetic pole layer having a magnetic pole tip portion for emitting the magnetic flux generated by the thin film coil toward a recording medium traveling in a predetermined medium travel direction, and extending from a recording medium facing surface which faces the recording medium in a direction away from the recording medium facing surface;

a first gap layer disposed so as to be adjacent to the magnetic pole tip portion in two side directions orthogonal to the medium outflow direction in the medium travel direction;

a second gap layer disposed so as to be adjacent to the magnetic pole tip portion in the medium outflow direction; and

a magnetic shield layer disposed so as to extend from the recording medium facing surface in the direction away from the recording medium facing surface and so as to surround the magnetic pole tip portion from three directions of the medium outflow direction and the two side directions via the first and second gap layers.